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A technique for estimating the time-of-track distribution of optical vehicle tracking systems

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A technique for estimating the time-of-track distribution of optical vehicle tracking systems

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An important metric for a broad-area optical tracking system is the length of time an object, such as a vehicle, can be tracked in a cluttered environment. Time-of-track is appropriately modeled as a random variable and depends on many factors including scene clutter, the object under track, the optical system used to collect the image sequence, and the tracking algorithm. Empirically estimating the time-of-track distribution can be difficult due to experiment costs and other factors. Models of the tracking process can provide insight into the time-of-track distribution, but developing realistic models for scene clutter, vehicle and image sequences can be very difficult. In contrast, the approach presented here uses a Markov chain to model vehicle tracking, but derives transition probabilities from real-world vehicle tracking. This approach allows us to readily estimate time-of-track distributions without resorting to complicated scene, vehicle, and imagery models.

We begin by briefly describing the essential components of an optical vehicle tracking algorithm. These include a vehicle dynamics model and a frame-to-frame vehicle correspondence algorithm. The Markov chain used to model vehicle tracking is next presented, along with the statistical assumptions critical to the technique. The Markov chain changes state with each new frame, and consists of several states including: 1) continue track, 2) extrapolate track, and 3) lose vehicle track. Techniques for estimating the transition probabilities of the Markov chain from the image sequence and vehicle track files are described. Finally, examples of time-of-track distributions are given to illustrate the technique.

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